

(d) drying the wet-laid continuous paper sheet of said step (c) for creating a relatively soft, compliant fiber matrix from which polishing pads for use in chemical mechanical polishing of substrates are formed.

R E M A R K S

The present amendment has been submitted in order to amend the claims. No new matter has been added. .

Respectfully submitted,

By: 

Milton S. Gerstein
Reg. No. 27,891

Much, Shelist, Freed
191 N. Wacker Drive
Suite 1700
Chicago, Illinois 60606
(312) 521-2776

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

CLAIM 1(AMENDED). A process of making polishing [Polishing pads] for use in chemical mechanical polishing of substrates, each said polishing pad having a ground polishing surface and consisting of a porous fibrous matrix of paper-making fibers, fillers, and a binder for binding said fibrous matrix, said binder consisting of thermoset resin, said matrix and said binder forming a porous structure by which polishing slurry or polishing debris during chemical mechanical polishing of substrates are temporarily stored for subsequent rinsing away and for enhanced flow-distribution of the polishing slurry; said ground polishing surface consisting of a ground surface in order that said matrix thereat is of open-pore construction and defines surface asperities by which said optimal distribution of polishing slurry during chemical mechanical polishing of substrates is achieved, so that polishing slurry may be readily absorbed and optimally distributed during chemical mechanical polishing of substrates, said [polishing pads being made by a] process comprising:

- (b) making said polishing pads using a wet laid paper-making process;
- (b) said step (a) comprising forming a slurry of at least water, paper-making fibers, and latex;
- (c) mixing said slurry of said step (b) in order to disperse the fibers;
- (d) delivering said mixed slurry to a paper-making apparatus, and forming a wet-laid sheet;
- (e) drying the wet-laid sheet of said step (d);
- (f) adding and curing thermoset resin binder;

- (g) said step (f) comprising at least one of: adding the thermoset resin during said step (b), and after said step (e);
- (h) cutting the sheet to form polishing pads of desired size;
- (i) grinding at least one surface face of each said polishing pad to form said asperities and to open the porous matrix for polishing slurry transport during CMP processes; and
- (j) adding nanometer-sized conditioning-reinforcing filler particles so that each said ground polishing surface is reinforced to improve resistance to wear during conditioning of said ground polishing surface by a conditioning disk so that said polishing surface requires less frequent and less vigorous conditioning after repetitive uses.

CLAIM 2(AMENDED). The [polishing pads made by] process of making polishing pads according to claim 1, wherein said step (h) is performed before or after said step (f).

CLAIM 3(AMENDED). The [polishing pads] process according to claim 1, wherein:

said step (f) is performed after said step (e) and comprises impregnating the dry sheet of said step (e); said step of adding conditioning-reinforcing filler particles of said step (j) comprising adding said conditioning-reinforcing filler particles to said thermoset resin of said step (f) to form a mixture thereof.

CLAIM 4(AMENDED). The [polishing pads] process according to claim 3, wherein:

said step of impregnating of said step (f) comprises saturating the dry raw paper of said step (e) in said solution of thermoset resin and said conditioning-reinforcing filler particles.

CLAIM 5(AMENDED). The [polishing pads] process according to claim 3, wherein:

said step of impregnating of said step (f) comprises saturating the dry raw paper of said step (e) in said solution of thermoset resin and said conditioning-reinforcing filler particles having a solids ratio of thermoset resin to conditioning-reinforcing filler particles in the range of approximately 20:1 to 1:1 by weight.

CLAIM 6(AMENDED). The [polishing pads] process according to claim 1, wherein:

said step (f) is performed after said step (e) and comprises impregnating the dry sheet of said step (e); said step (j) being performed before said step (f) and comprising saturating the dry sheet of said step (e) in a colloidal mixture of said conditioning-reinforcing filler particles.

CLAIM 7(AMENDED). The [polishing pads] process according to claim 3, wherein said step (f) further comprises at least one of: pressing the thermoset resin via a hard-roll squeeze nip into the paper; vacuum-pulling the thermoset resin into the paper in order to ensure resin penetration into the center of the material; and wiping off excess resin therefrom.

CLAIM 8(AMENDED). The [polishing pads] process according to claim 1, wherein said step of adding of said (j) comprises:

- (k) adding spherical-shaped or platelet-shaped conditioning-reinforcing filler-particles of between 2 - 130 nanometers in size.

CLAIM 9(AMENDED). The [polishing pads] process according to claim 8, wherein said step of adding of said (k) comprises adding colloidal silica particles.

CLAIM 10(AMENDED). The [polishing pads] process according to claim 1, wherein said step (j) is performed during said step (b); said step (b) comprising forming a slurry consisting of the following base fiber matrix, by weight: 40 to 95% cellulosic fiber, 1 - 30% colloidal silica, and 1 - 20% latex at a raw base density of from approximately 0.200 to 0.500 g/cc.

CLAIM 11(AMENDED). The [polishing pads] process according to claim 1, wherein:

said step (f) is performed after said step (e) and comprises impregnating the dry sheet of said step (e); said step of adding conditioning-reinforcing filler particles of said step (j) comprising adding said conditioning-reinforcing filler particles to said thermoset resin of said step (f) to form a mixture thereof;

said step of impregnating comprising immersing said sheet of said step (e) in a bath of thermoset resin solution consisting of thermoset resin and said conditioning-reinforcing filler particles until completely saturated with the saturant solution; and removing excess resin and evaporating the solvent; said step (k) forming a resin-impregnated matrix with a colloidal filler content of between 1%-30% by weight.

CLAIM 12(AMENDED). The [polishing pads] process according to claim 1, wherein said step (f) comprises adding thermoset resin in an amount in order that each said polishing pad has thermoset resin-content in the range of 20% - 60% by weight.

CLAIM 13(AMENDED). The [polishing pads] process according to claim 1, wherein said step (i) comprises grinding with grit size of approximately between 320 and 36 grit to form asperities in the approximate range of between 2 - 35 micrometers in each of height, width and length.

CLAIM 14(AMENDED). The [polishing pads] process according to claim 1, wherein said step (i) comprises grinding both surfaces faces of each said polishing pad to a desired final thickness.

CLAIM 15(AMENDED). The [polishing pads] process according to claim 1, further comprising:

(k) forming grooves in the polishing-surface face of each said polishing pad to a depth less than the thickness of the polishing pad.

CLAIM 16(AMENDED). The [polishing pads] process according to claim 15, wherein said step (k) comprises forming arc-radial grooves.

CLAIM 17(AMENDED). The [polishing pads] process according to claim 16, wherein said step (k) comprises forming between 5 and 40 arc-radial grooves with each said groove having a depth between approximately 50% to 90% of said final thickness.

CLAIM 18(AMENDED). The [polishing pads] process according to claim 15, wherein said step (k) comprises forming each said groove to a width of between approximately 1/16 in. and 1/2 in.

CLAIM 19(AMENDED). The [polishing pads] process according to claim 15, wherein said step (k) comprises forming each said groove to a depth of within approximately 0.005 – 0.015 in. of the total pad thickness.

CLAIM 20(AMENDED). The [polishing pads] process according to claim 1, wherein said step (i) comprises removing approximately 0.010 to 0.020 in. from the polishing surface in order to remove the resin-rich skin layer and to open the porosity of the pad.

CLAIM 21(AMENDED). The [polishing pads] process according to claim 20, wherein said step (i) further comprises: removing up to 0.015 in. from the surface opposite said polishing surface for thickness control.

CLAIM 22(AMENDED). The [polishing pads] process according to claim 1, wherein said step (i) comprises grinding the polishing surface with a 60 – 120 grit media.

CLAIM 23(AMENDED). The [polishing pads] process according to claim 1, wherein said step of adding of said step (j) is performed during said step (b); said step (b) further comprising lowering the pH in order to retain the conditioning-reinforcing filler particles in said slurry.

CLAIM 24(AMENDED). The [polishing pads] process according to claim 23, wherein said step of lowering the pH comprises lowering the pH to approximately between 4 and 5.

CLAIM 25(AMENDED). The [polishing pads] process according to claim 1, wherein said step (e) dries said sheet to a nominal dry basis of approximately 531 pounds/3000ft² +/- 10%.

CLAIM 26(AMENDED). The [polishing pads] process according to claim 1, wherein said step (e) comprises drying said sheet to a thickness of between approximately .050 to .100 in. and to an approximate 1% moisture content.

CLAIM 27(AMENDED). The [polishing pads] process according to claim 1, wherein said step (b) comprises forming a slurry consisting, by weight, of : 40-95% cotton linters, 1-10% lyocell fiber; 1-30% latex binder.

CLAIM 28(AMENDED). The [polishing pads] process according to claim 1, wherein said step (b) comprises forming a slurry consisting, by weight, of 90% cotton linters, 10% latex and 5% 15- nanometer colloidal silica particles; and at least one of a colloidal-silica particle-retention agent and a pH-lowering agent for retaining the colloidal silica.

CLAIM 29(AMENDED). The [polishing pads] process according to claim 1, wherein said step (b) comprises forming a base-paper slurry consisting of: 70-80% cotton linters at a contamination level of 0.25 parts per million, 8-12% lyocell fiber, 8-12% acrylonitrile latex, and 3-10% colloidal silica.

CLAIM 30(AMENDED). In a method of making [In] a fiber matrix for use in making polishing pads for use in chemical-mechanical process apparatuses for the chemical-mechanical polishing of substrates, the improvement comprising:

said fiber matrix being made by a paper-making wet-laid process comprising the following steps:

- (e) mixing paper-making cellulosic fibers and nanometer-sized filler particles in water to form a paper-making slurry;
- (f) delivering the paper-making slurry of said step (a) to a paper-making machine and making a paper sheet in said paper-making machine;
- (g) said step (b) comprising draining water from the slurry to form a continuous paper sheet;
- (h) drying the wet-laid continuous paper sheet of said step (c) for creating a relatively soft, compliant fiber matrix from which polishing pads for use in chemical mechanical polishing of substrates are formed.